

## CLAIMS

What is claimed is:

1. A method of producing an adsorption medium, comprising:  
dissolving at least one metal compound in a solvent to form a metal solution;  
dissolving polyacrylonitrile (PAN) into the metal solution to form a PAN-metal solution;  
and  
depositing the PAN-metal solution into a quenching bath.
2. The method of claim 1, wherein dissolving at least one metal compound in a solvent to form a metal solution comprises dissolving at least one metal salt, at least one metal oxide, or mixtures thereof in the solvent.
3. The method of claim 1, wherein dissolving at least one metal compound in a solvent to form a metal solution comprises dissolving at least one salt or at least one oxide of a divalent, a trivalent, or a tetravalent metal in the solvent.
4. The method of claim 1, wherein dissolving at least one metal compound in a solvent to form a metal solution comprises dissolving at least one salt or at least one oxide of at least one of a transition metal, a lanthanide or rare earth metal, a Group III metal, a Group IV metal, or a Group V metal in the solvent.
5. The method of claim 1, wherein dissolving at least one metal compound in a solvent to form a metal solution comprises dissolving the at least one metal compound having a metal cation selected from the group consisting of iron, zirconium, lanthanum, cerium, titanium, aluminum, tin, silver, zinc, mercury, bismuth, copper, antimony, tungsten, and molybdenum in the solvent.
6. The method of claim 1, wherein dissolving at least one metal compound in a solvent to form a metal solution comprises dissolving at least one metal salt selected from the group

consisting of a metal chloride, a metal oxychloride, a metal sulfate, a metal nitrate, and a metal acetate in the solvent.

7. The method of claim 1, wherein dissolving at least one metal compound in a solvent comprises dissolving the at least one metal compound in concentrated nitric acid.

8. The method of claim 1, wherein dissolving at least one metal compound in a solvent comprises dissolving the at least one metal compound in an amount sufficient to produce the metal solution saturated with the at least one metal compound.

9. The method of claim 1, wherein dissolving polyacrylonitrile into the metal solution comprises dissolving from approximately 3% by weight to approximately 5% by weight PAN into the metal solution.

10. The method of claim 1, wherein depositing the PAN-metal solution into a quenching bath comprises spraying the PAN-metal solution into the quenching bath that includes an alkaline agent.

11. The method of claim 10, wherein depositing the PAN-metal solution into the quenching bath comprises spraying the PAN-metal solution into the quenching bath comprising approximately 0.1M sodium hydroxide to approximately 8M sodium hydroxide.

12. The method of claim 1, wherein producing the adsorption medium further comprises simultaneously precipitating at least one metal hydroxide from the PAN-metal solution and insolubilizing the PAN in the PAN-metal solution.

13. The method of claim 12, wherein producing the adsorption medium further comprises producing a solid bead comprising the at least one metal hydroxide incorporated into the PAN.

14. The method of claim 1, wherein producing the adsorption medium further comprises impregnating a support with the adsorption medium.

15. The method of claim 12, wherein producing the adsorption medium further comprises impregnating a support with the at least one metal hydroxide incorporated into the PAN.

16. The method of claim 12, wherein producing the adsorption medium further comprises producing the adsorption medium having from approximately 10% by weight to approximately 85% by weight of a metal in the form of an elemental metal and the at least one metal hydroxide and from approximately 15% by weight to approximately 90% by weight of the PAN.

17. A method of removing a constituent from a feed stream, comprising:  
providing an adsorption medium having a polyacrylonitrile (PAN) matrix and at least one metal hydroxide homogenously dispersed in the PAN matrix, the adsorption medium having from approximately 10% by weight to approximately 85% by weight of a metal in the form of an elemental metal and the at least one metal hydroxide and from approximately 15% by weight to approximately 90% by weight of the PAN;

contacting the adsorption medium with a feed stream comprising at least one constituent;  
and

removing the at least one constituent from the feed stream.

18. The method of claim 17, wherein contacting the adsorption medium with a feed stream comprising at least one constituent comprises contacting the adsorption medium with a feed stream comprising at least one constituent selected from the group consisting of arsenic, selenium, and antimony.

19. The method of claim 17, wherein contacting the adsorption medium with a feed stream comprising at least one constituent comprises contacting the adsorption medium with the feed stream comprising an oxyanion or an oxyacid of arsenic, selenium, or antimony.

20. The method of claim 17, wherein removing the at least one constituent from the feed stream comprises reducing an amount of arsenic in the feed stream to less than approximately 50 parts per billion.

21. The method of claim 17, wherein removing the at least one constituent from the feed stream comprises reducing an amount of arsenic in the feed stream to less than approximately 10 parts per billion.

22. An adsorption medium having an increased metal loading, comprising:

a polyacrylonitrile (PAN) matrix and at least one metal hydroxide, the adsorption medium having from approximately 10% by weight to approximately 85% by weight of a metal in the form of an elemental metal and the at least one metal hydroxide and from approximately 15% by weight to approximately 90% by weight of the PAN.

23. The adsorption medium of claim 22, wherein the adsorption medium comprises at least approximately 50 wt% of the metal in the form of an elemental metal and the metal hydroxide.

24. The adsorption medium of claim 22, wherein the at least one metal hydroxide is substantially homogenously dispersed in the polyacrylonitrile matrix.

25. A method of producing an adsorption medium, comprising:

dissolving polyacrylonitrile (PAN) in an organic solvent to form a PAN solution;

adding at least one metal oxide to the PAN solution to form a metal oxide-PAN solution;

and

depositing the PAN-metal solution into a quenching bath.

26. The method of claim 25, wherein adding at least one metal oxide to the PAN solution to form a metal oxide-PAN solution comprises adding at least one powdered metal oxide to the PAN solution.

27. The method of claim 25, wherein depositing the PAN-metal solution into a quenching bath comprises depositing the PAN-metal solution into a water bath.